

REMARKS

Status of Claims:

Claims 1, 4, 8, and 11 are amended. Claim 9 is cancelled. Claims 12-17 are added as new claims. Claims 1, 3-8, and 10-17 remain for examination.

Claim Objections:

Claims 1 and 3-11 are objected to for the informalities that the “said source extension region” and “said source and drain extension regions” of claims 1, 4, 8, and 11 lack sufficient antecedent basis. Claims 1, 4, and 8 are now amended such that they do not recite “said source extension region” or “said source and drain extension regions”. Claim 11 is amended such that the “extension region” has sufficient antecedent basis. It is thus submitted that the current claim amendments remove the basis for the informality objections.

Prior Art Objections:

Claims 1 and 3-11 stand rejected under 35 U.S.C. 103(a) as being obvious over Admitted Prior Art (APA) in view of Duvvury, Watt, and Van Roozendaal et al.

The Examiner’s rejections are respectfully traversed.

1) Van Roozendaal:

On page 4 of the Office Action, the Examiner stated that “Van Roozendaal et al. teach the advantage of forming a first conductive type well directly under the first source diffusion layer (col. 8, ll. 60-65).” As shown in Fig. 6, Van Roozendaal et al. teaches forming conductive types (21d and 22d) well under both the source diffusion 22 and drain diffusion 21 layers.

Claim 1 is now amended to recite “a first conductive type well having a lower dopant concentration than the dopant concentration of the source diffusion layer is formed directly under the source diffusion layer and thereby the first conductive type well is electrically connected directly with the source diffusion layer, wherein no first conductive type well is

formed under or electrically connected to the drain diffusion layer.” Furthermore, Claim 1 recites the limitation of “wherein the drain diffusion layer is connected directly to an input/output terminal section without an intervening resistance element.”

In Claim 1, the first conductive type well is formed only under the source diffusion layer, and not under the drain diffusion layer. As shown in Fig. 5 of the present application, the first conductive type well formed only under the source diffusion layer creates a current path for the surge current such that the electric potential of the base region of the NPN parasitic bipolar transistor is raised after the breakdown. Accordingly, because of the increase in the base region potential, the snap-back can be easily induced. (See Pg. 22, ll. 6-21 of the present application.)

In contrast, the structure recited in Van Roozenbaal et al. cannot create the current path described above because there is a first conductive type well under both the source diffusion layer and the drain diffusion layer. (See Fig. 6 of Van Roozenbaal et al., 21d and 22d under source diffusion 22 and drain diffusion 21.) Furthermore, the drain diffusion layer of the present application is connected to an input/output terminal. If the structure in Van Roozenbaal is applied to the present invention, a first conductive type well under the drain diffusion layer would create an electrical connection between the input/output terminal and the substrate, hence this connection creates a leakage current between the input/output terminal and the substrate. On the other hand, the first conductive type well under the source diffusion region would not create such a leakage current, because the source diffusion region is connected to the ground terminal 9 (reference potential).

Therefore, one cannot combine the teachings of the APA and Van Roozenbaal to reach the feature of a first conductive type well under only the source diffusion layer and no first conductive-type well under the drain diffusion layer.

Independent Claims 4, 8, and 11 also contain the feature of “wherein no first conductive type well is formed under or electrically connected to the drain diffusion layer.” Hence they are distinguishable from Van Roozenbaal as well.

2. Duvvury:

The Examiner states on Page 4 of the Office Action that “Duvvury teach in figure 6 (or figure 9) and related text a first conductive type well 22 (or 142) formed directly under the first source diffusion layer 12 (or 144) and thereby the first conductive type well is electrically connected directly with the source diffusion layer, wherein the first conductive type well at least partially underlies the element isolation film 28 (or 128), and having a lower dopant concentration than the first diffusion layer.”

In Figure 9 of Duvvury, the first conductive type well (N- well 142) is formed directly under the N+ region 114, and is electrically connected with the N+ region 114. The first conductive type well (N- well 142) also extends under the N+ region 144 and P+ region 146, thus the first conductive type well (142) electrically connects regions 144 and 146 to the N+ region 114. Furthermore, Duvvury recites that the N+ region 112 is coupled with a reference node or ground node, and regions 144 and 146 are coupled to an input/output pad. (Duvvury, col. 7, ll. 2-4.) Accordingly, both the N+ region 114 and the 144 are electrically connected to the input/output pad. Therefore, the N+ region 144 is a drain diffusion layer, not a source diffusion layer as the Examiner stated. Hence, Duvvury teaches a structure in which a first conductive type well 142 is formed under the drain diffusion layer (114 and 144) that is connected to an input/output pad.

In addition, according to Fig. 9 of Duvvury, another N- well region 122 is formed under the source diffusion layer 112, which is connected to the reference node or ground node. As shown in Fig. 9, the 122 region does not partially underlie the element isolation film 130.

In contrast, Claim 1 of the present application is amended to recite that “no first conductive type well is formed under or electrically connected to the drain diffusion layer,” with the limitation that the first conductive type well formed under the source diffusion layer “at least partially underlies the element isolation film.” In addition, Claim 1 recites the further limitations that “wherein the drain diffusion layer is connected directly to an

input/output terminal section without an intervening resistance element.” The structure in Fig. 9 of Duvvury shows a first conductive type well (regions 142) formed under the drain diffusion layer (144 or 114), which is connected to an input/output terminal section, and a first conductive region 122 formed under the source diffusion layer 112 that does not partially underlie the element isolation film 130.

The similar limitation applies to Fig. 6 of Duvvury as well. Duvvury describes that low avalanche breakdown is desired between region 12 and the substrate 26, and that the N-well region 22 is placed between region 12 and substrate 26 to increase the avalanche threshold. (Duvvury, col. 3, ll. 41-49.) It is well known to those skilled in the art that avalanche breakdown between region 12 and substrate 26 can only happen if the two regions have different voltage potentials. Avalanche breakdown cannot happen if both region 12 and substrate 26 are connected to ground. According to Duvvury, the substrate 26 is connected to the ground plane. (Duvvury, col. 3, ll. 31-37.) Therefore, region 12 in Fig. 6 of Duvvury is not connected to ground, since otherwise there would be no reason to place region 22 between region 12 and substrate 26 to increase the avalanche breakdown threshold. Since region 12 is not connected to ground, it is not a source diffusion layer as defined in the present application. This is true since claim 1 recites that the “source diffusion layer is also connected to said reference potential.” Hence in claim 1, the source diffusion layer is connected to the reference potential (ground).

Therefore, one cannot combine the teachings of the APA and Duvvury to reach the features recited in Claim 1 of the present application that “no first conductive type well is formed under or electrically connected to the drain diffusion layer” with the further limitation of “wherein the source diffusion layer is also connected to said reference potential.” Similar limitations apply to independent claims 4, 8, and 11 as well.

3. Watt

The deficiencies of Duvvury and Van Roozendaal et al. are not cured by Watt. Watt does not recite the feature of “a first conductive type well having a lower dopant concentration than the dopant concentration of the source diffusion layer is formed directly

under the source diffusion layer and thereby the first conductive type well is electrically connected directly with the source diffusion layer, wherein no first conductive type well is formed under or electrically connected to the drain diffusion layer,” with the further limitation of “wherein said dopant diffusion region is connected to a reference potential.”

Furthermore, Figs. 6 of Watt shows the formation of a LDD (lightly doped drain) region 62 used in combination with depletion implant 56_i to increase the breakdown voltage between the N⁺ drain and P substrate junction. In contrast, Claims 11, 13, 15, and 17 recite an extension region without the depletion implant. Hence, Claims 11, 13, 15, and 17 are allowable for this reason in addition to the reasons stated above.

Conclusion:

Similar limitations to those discussed above are present in ALL of applicant's independent claims. It is thus submitted that the PTO has not made out a prima facie case of obviousness under the provisions of 35 U.S.C. § 103, and thus applicants claims are patentable over the prior art.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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